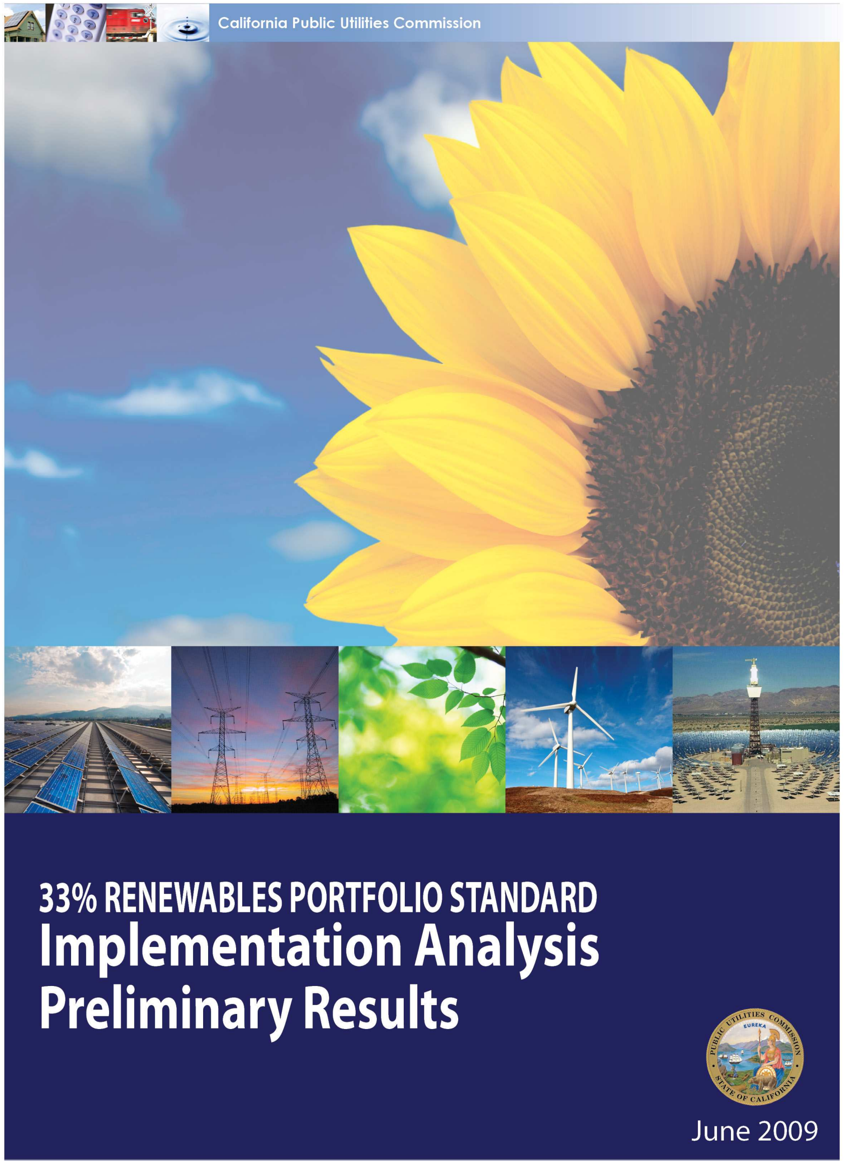



# 33% RPS Implementation Analysis

## Methodology Overview

CPUC Presentation at
CARB RES Workshop

December 14, 2009

# Purpose and Scope of Analysis

- CPUC's Energy Division staff initiated this analysis in order to answer two key questions:
  - What steps will the state need to take to reach a 33% RPS by 2020?
  - How much will it cost to meet a 33% RPS by 2020?
- Scope of analysis included:
  - Estimate the amount of generation and transmission needed to reach a 33% RPS
  - Several procurement strategies (cases) for achieving a 33% RPS by 2020
  - Calculated the projected cost of different RPS cases in the year 2020
  - Timelines for generation and transmission facilities needed to reach a 33% RPS

# 33% Implementation Analysis - Workplan

- Phases 1 and 2 of 33% Implementation Analysis addressed:
  - Analyzed the cost of four different 33% procurement strategies
  - Assessed the transmission needs of the 33% reference case and likely construction time
  - Identified market and regulatory barriers to renewable development
- Preliminary results for phases 1 and 2 were released June 2009
- 33% Implementation Analysis will be revised and updated for use in CPUC's long-term resource planning process (Feb 2009):
  - Updates transmission cost and timing based on RETI and CAISO 33% conceptual transmission plan
  - Updates integration costs based on CAISO's 33% integration study
  - Updates load forecast based on CEC's 2009 IEPR update

# Portfolio Options for Achieving 33%

| Case Name | Description |
| --- | --- |
| **20% RPS Reference Case** | Utilities procure 35 TWh of additional renewables to meet a 20% RPS target by 2020. |
| **33% RPS Reference Case** | Utilities procure 75 TWh of additional renewables to meet a 33% RPS target by 2020. There is heavy emphasis on projects that are already either contracted or short-listed with California IOUs, which includes a significant proportion of solar thermal and solar photovoltaic resources. |
| **High Wind Case** | Assumes less reliance on in-state solar thermal and more reliance on the less expensive wind resources in California and Baja. |
| **High Out-of-State Delivered Case** | Allows construction of new, long-line, multi-state transmission to allow California utilities to procure large quantities of low-cost wind and geothermal resources in other western states. Does not use tradable renewable energy certificates as a compliance tool. Thus, all out-of-state electricity is delivered to California. |
| **High DG Case** | Assumes limited new transmission corridors are developed to access additional renewable resources to achieve a 33% RPS. Instead, extensive, smaller-scale renewable generation is located on the distribution system and close to substations. |

# Major Cost Assumptions

- Projected costs are based on renewable technology costs and not the contract prices.
- The cost analysis assumes current technology costs, and makes no assumptions about the cost trajectory (up or down) of particular technologies over time due to potential transformation of the market.
- Average electricity costs per kilowatt hour are expressed as statewide averages and are not indicative of individual utilities' rates or the actual bills that consumers will pay.

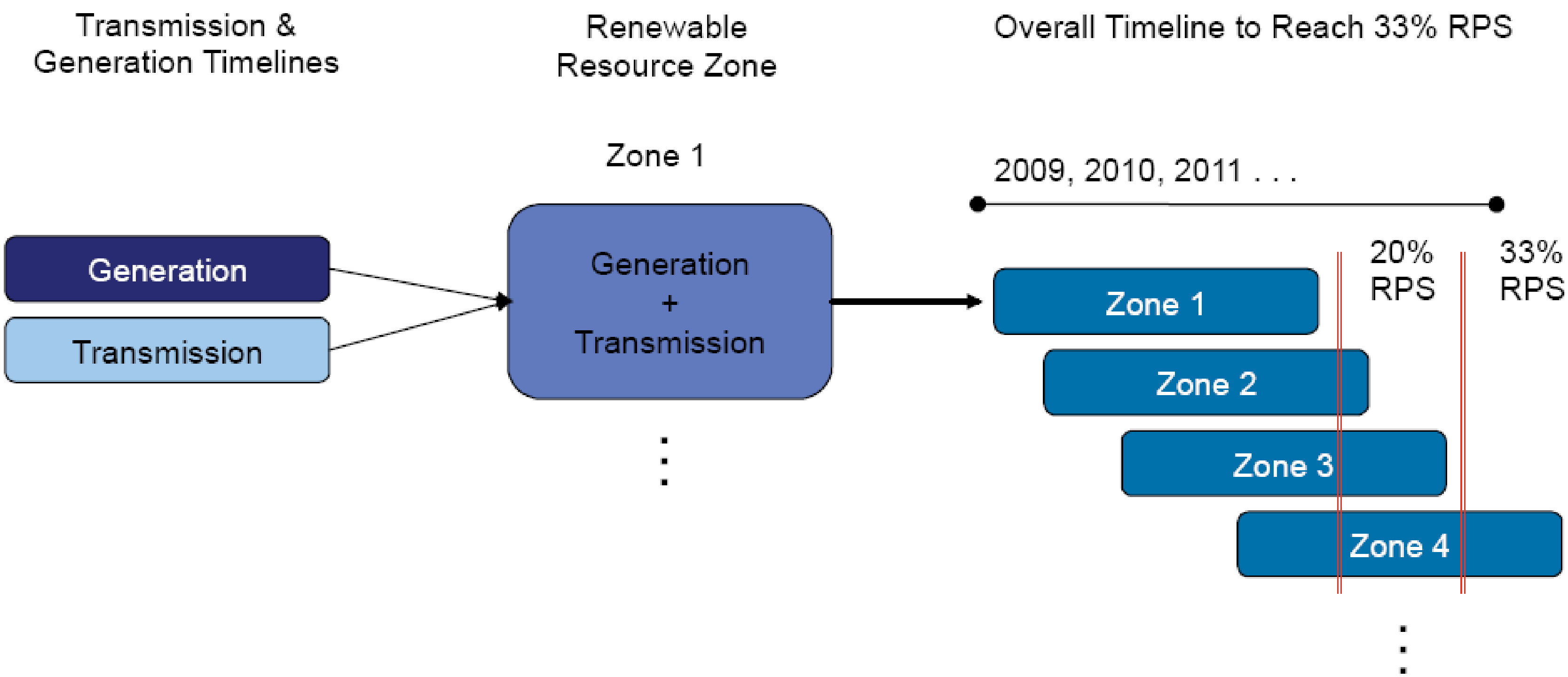
# Four Sources of New Resources to Fill Resource Gap

- ED Project Database
  - Contracted or short-listed utility projects
  - ED ratings of project viability
- RETI database
  - Pre-identified and proxy projects for California and BC
- E3 GHG Calculator
  - Estimates of renewable resource availability by resource class for non-California regions
- Original Renewable DG resource potential estimates

# 33% Reference Case Generation Resources

- 20% RPS Reference Case (***9,437 MW***):
  - Tehachapi
  - Solano
  - Imperial North
  - Riverside East
  - distributed + out-of-state projects
- 33% RPS Reference Case (***14,361 MW***):
  - 20% Case – all resources
  - Mountain Pass
  - Carrizo North
  - Needles
  - Kramer
  - Fairmont
  - San Bernardino-Lucerne
  - Palm Springs
  - Baja
  - Riverside East incremental
  - distributed + out-of-state projects

# Developing Overall Timelines for the 33% RPS Reference Case

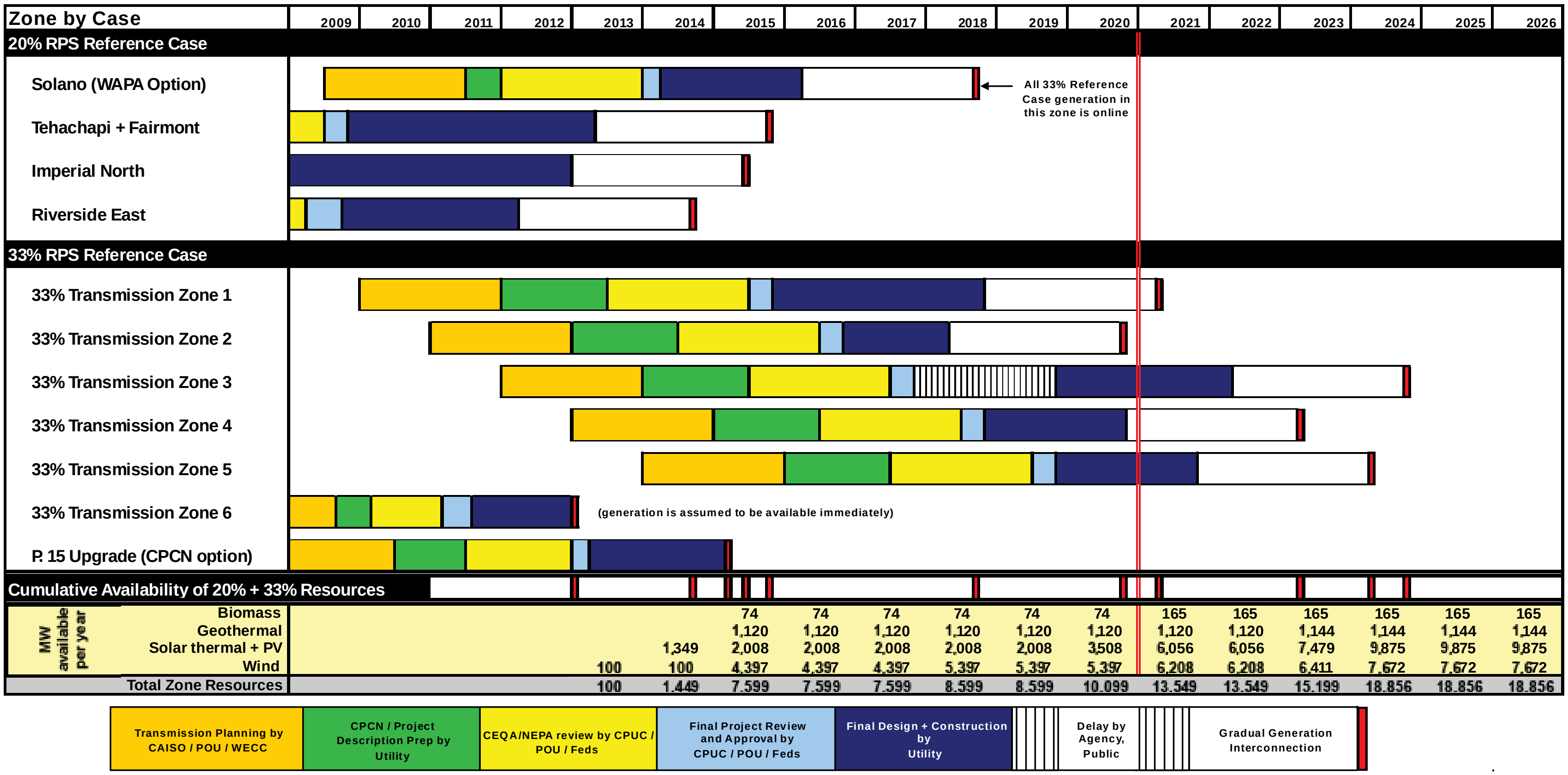



Source: CPUC/Aspen

# 33% RPS Reference Case Timelines

- **Timeline 1 (Historical experience without process reform)**
  - 33% RPS achieved in 2024
  - Assumes planning, permitting, and construction processes are almost entirely sequential.
- **Timeline 2A (Current practice with process reform & no external risks)**
  - 33% RPS achieved in 2021
  - Assumes successful implementation of reforms currently in process
  - Timeline assumes no delays due to external risks beyond state control
- **Timeline 2B (Current practice with process reform & external risks)**
  - 33% RPS not achieved
  - Assumes state successfully implements reforms, but factors outside state control (e.g., technology failure, financing risk, environmental risk, and public opposition/legal challenges) cause delay or failure of some projects

# Timeline 1 - Historical Experience Without Process Reform

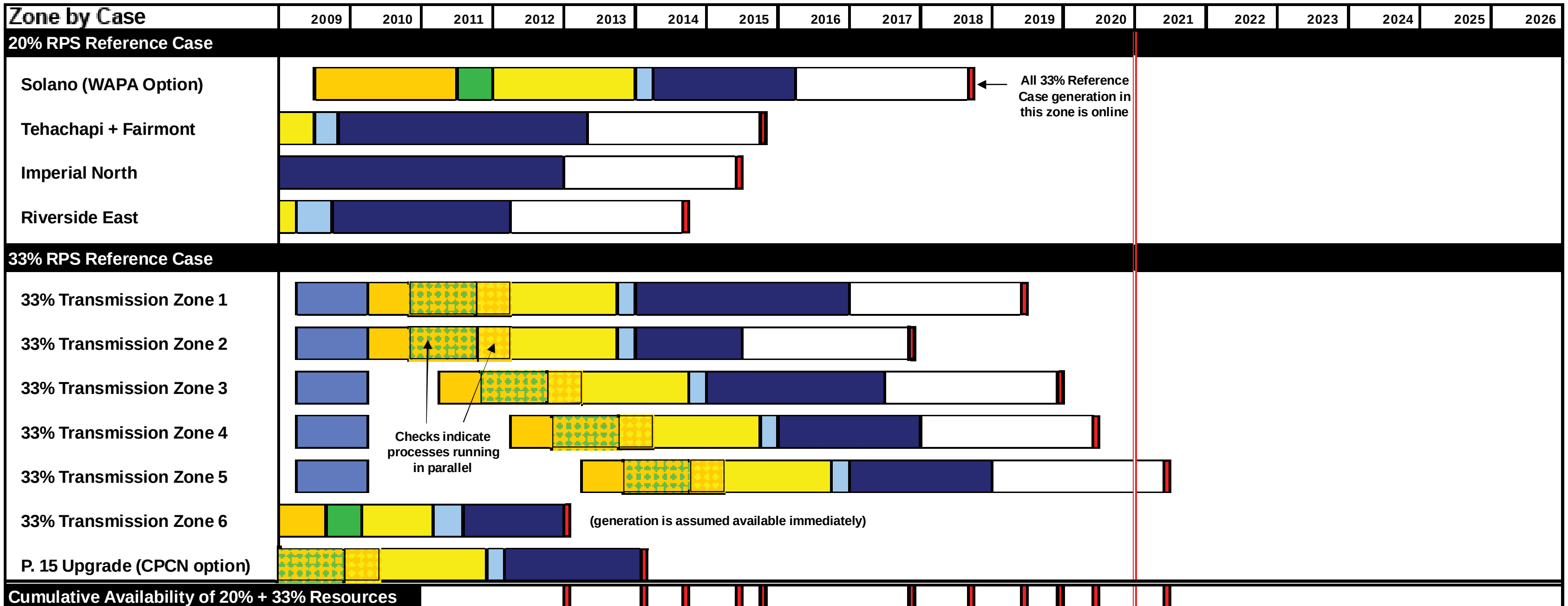



| MW available per year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Biomass | | | | | | | 74 | 74 | 74 | 74 | 74 | 74 | 165 | 165 | 165 | 165 | 165 | 165 |
| Geothermal | | | | | | | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 | 1,144 | 1,144 | 1,144 | 1,144 |
| Solar thermal + PV | | | | | | 1,349 | 2,008 | 2,008 | 2,008 | 2,008 | 2,008 | 3,508 | 6,056 | 6,056 | 7,479 | 9,875 | 9,875 | 9,875 |
| Wind | | | | | 100 | 100 | 4,397 | 4,397 | 4,397 | 5,397 | 5,397 | 5,397 | 6,208 | 6,208 | 6,411 | 7,672 | 7,672 | 7,672 |
| Total Zone Resources | | | | | 100 | 1,449 | 7,599 | 7,599 | 7,599 | 8,599 | 8,599 | 10,099 | 13,549 | 13,549 | 15,199 | 18,856 | 18,856 | 18,856 |

Source: CPUC/Aspen

- **Result: 33% RPS achieved in 2024**

# Timeline 2A - Current Practice With Process Reform & No External Risks

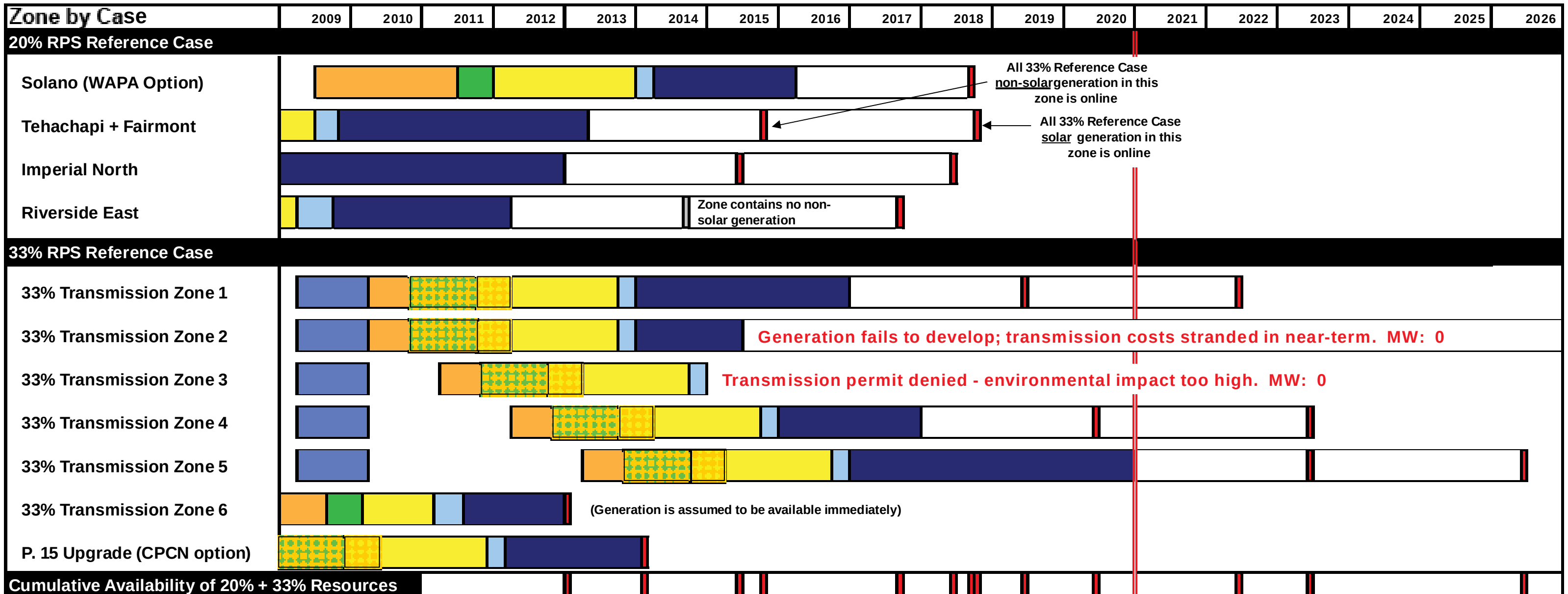



| MW available per year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Biomass | | | | | | | 74 | 74 | 74 | 74 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| Geothermal | | | | | | | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 | 1,144 | 1,144 | 1,144 | 1,144 | 1,144 | 1,144 | 1,144 |
| Solar thermal + PV | | | | | | 1,349 | 2,008 | 2,008 | 3,508 | 3,508 | 7,707 | 9,130 | 9,875 | 9,875 | 9,875 | 9,875 | 9,875 | 9,875 |
| Wind | | | | | 100 | 100 | 4,397 | 4,397 | 4,397 | 5,397 | 7,014 | 7,217 | 7,672 | 7,672 | 7,672 | 7,672 | 7,672 | 7,672 |
| Total Zone Resources | | | | | 100 | 1,449 | 7,599 | 7,599 | 9,099 | 10,099 | 16,006 | 17,656 | 18,856 | 18,856 | 18,856 | 18,856 | 18,856 | 18,856 |

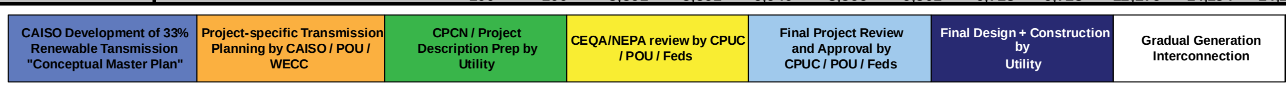
Source: CPUC/Aspen

- **Result: 33% RPS achieved in 2021**

# Timeline 2B - Current Practice With Process Reform & External Risks




| MW available per year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Biomass | | | | | | | 74 | 74 | 74 | 74 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| Geothermal | | | | | | | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 | 1,144 | 1,144 | 1,144 | 1,144 | 1,144 | 1,144 | 1,144 |
| Solar thermal + PV | | | | | | | | | 1,349 | 2,008 | 2,008 | 2,008 | 2,008 | 4,556 | 5,979 | 5,979 | 5,979 | 6,724 |
| Wind | | | | | 100 | 100 | 4,397 | 4,397 | 4,397 | 5,397 | 6,208 | 6,411 | 6,411 | 6,411 | 6,866 | 6,866 | 6,866 | 6,866 |
| Total Zone Resources | | | | | 100 | 100 | 5,591 | 5,591 | 6,940 | 8,599 | 9,501 | 9,728 | 9,728 | 12,276 | 14,154 | 14,154 | 14,154 | 14,899 |




Source: CPUC/Aspen

- **Result: 33% RPS is not achieved, mitigating strategies are needed**

# 33% RPS Reference Case 7.1% Higher Cost than 20% RPS Reference Case

| Category | 20% RPS Reference Case | 33% RPS Reference Case | 33% High Wind Case | 33% High Out-of-State Delivered Case | 33% High DG Case |
|---|---|---|---|---|---|
| Total Statewide Electricity Expenditures* | $50.6 | $54.2 | $52.7 | $52.5 | $58.0 |
| Average Statewide Electricity Cost | $0.158/kWh | $0.169/kWh | $0.164/kWh | $0.164/kWh | $0.181/kWh |
| Difference Relative to 20% RPS Reference Case* | N/A | +$3.6 | +$2.1 | +$1.9 | +$7.4 |
| Percent Difference Relative to 20% RPS Reference Case | N/A | +7.1% | +4.2% | +3.8% | +14.6% |
| Difference Relative to 33% RPS Reference Case* | N/A | N/A | -$1.5 | -$1.7 | +$3.8 |
| Percent Difference Relative to 33% RPS Reference Case | N/A | N/A | -2.8% | -3.1% | +7.0% |

*Expressed in billions of 2008 dollars in 2020.

# Sensitivity Analysis

- Projecting the costs of different renewable and fossil-fired energy sources out to 2020 requires numerous assumptions about future conditions including:
  - Natural gas and $CO_2$ allowance prices
  - Load growth (low-load sensitivity based on AB 32 Scoping Plan)
  - Technology costs (solar PV cost reductions)
- Many of these variables are highly uncertain, and some significantly influence the model's results

# More Information

- 33% RPS Report and RPS Calculator:
  – http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/33implementation.htm

- CPUC RPS Website
  – www.cpuc.ca.gov/renewables

# Back-up Slides

# Assumptions Used in All Cases

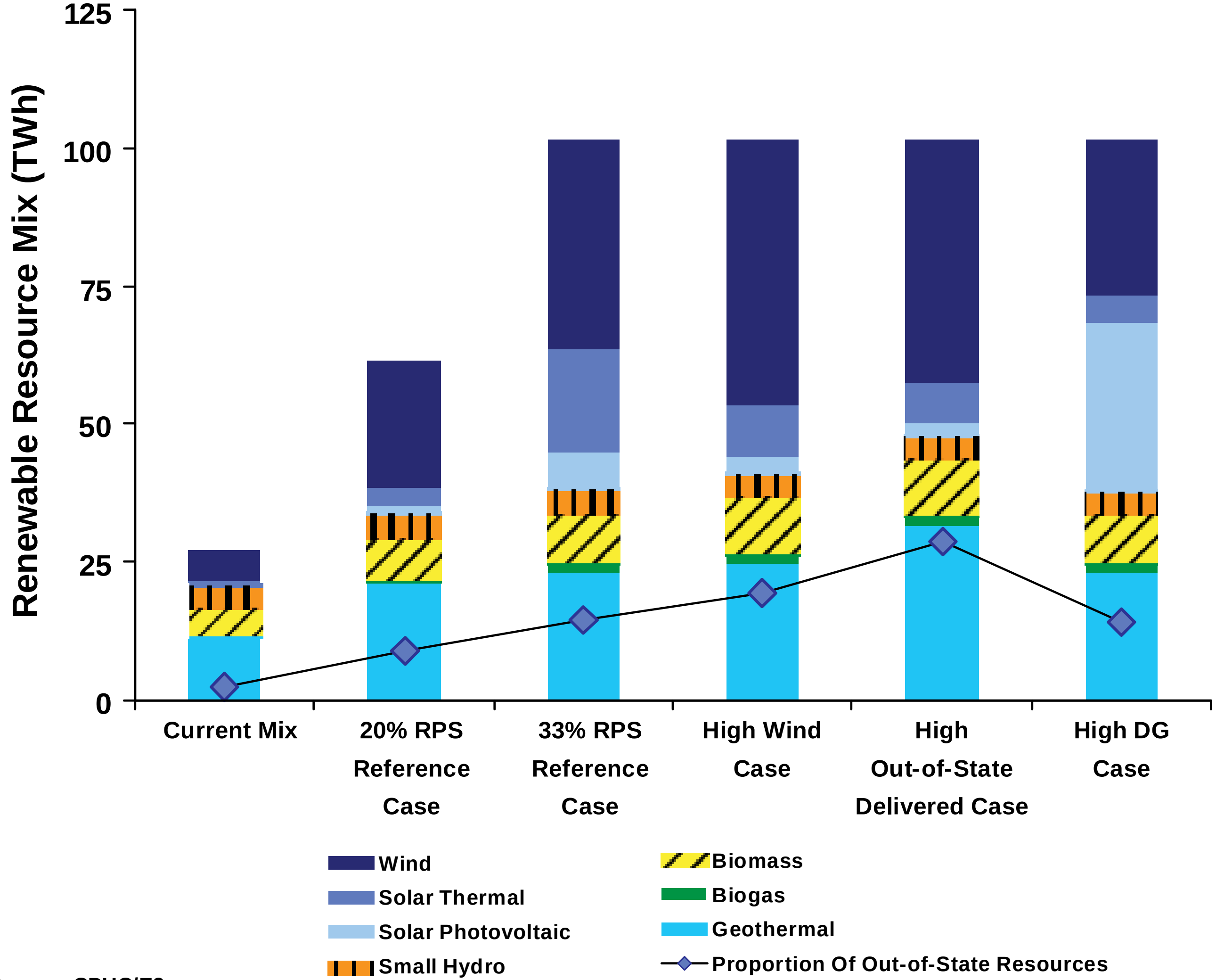
| Category | Assumption |
|---|---|
| Load forecast | Energy Commission's 2007 IEPR reference case or mid-case load forecast |
| Fuel price forecast | The Market Price Referent methodology, updated with new natural gas prices, was used to develop the base case forecast |
| $CO_2$ allowance price forecast | The Market Price Referent methodology was used for $CO_2$ price forecasts to develop the base case forecast |
| Energy efficiency achievement | No incremental energy efficiency assumed beyond what is already incorporated in the Energy Commission's 2007 IEPR load forecast |
| Demand response achievement | No incremental demand response assumed beyond what is already incorporated in the Energy Commission's 2007 IEPR load forecast |
| Combined Heat and Power (CHP) achievement | Energy Commission 2007 IEPR base-case load forecast assumption for CHP penetration |
| Customer-installed solar PV | Energy Commission 2007 IEPR load forecast, 847 MW nameplate of customer-installed PV |
| GHG allowance allocation | GHG emissions allowances are auctioned. Auction revenue from allowances equal to 2008 electricity sector emissions is returned to utilities |
| Resource characterizations | Reference case resource cost assumptions based on RETI and E3 data for renewable generation and the Market Price Referent for new combined-cycle gas turbines |

# 2007 IEPR Load Forecast Assumptions

| | 2007 IEPR Load Forecast Assumption used in 20% and 33% RPS Reference Cases |
|---|---|
| **Energy Efficiency (EE)** | 16 TWh of embedded EE (80% of the CPUC's 2020 EE goals[1] |
| **Customer-Installed Solar PV** | 847 MW nameplate of customer-installed PV[3] |
| **Demand Response** | No incremental demand response |
| **Combined Heat and Power (CHP)** | No incremental CHP assumed |

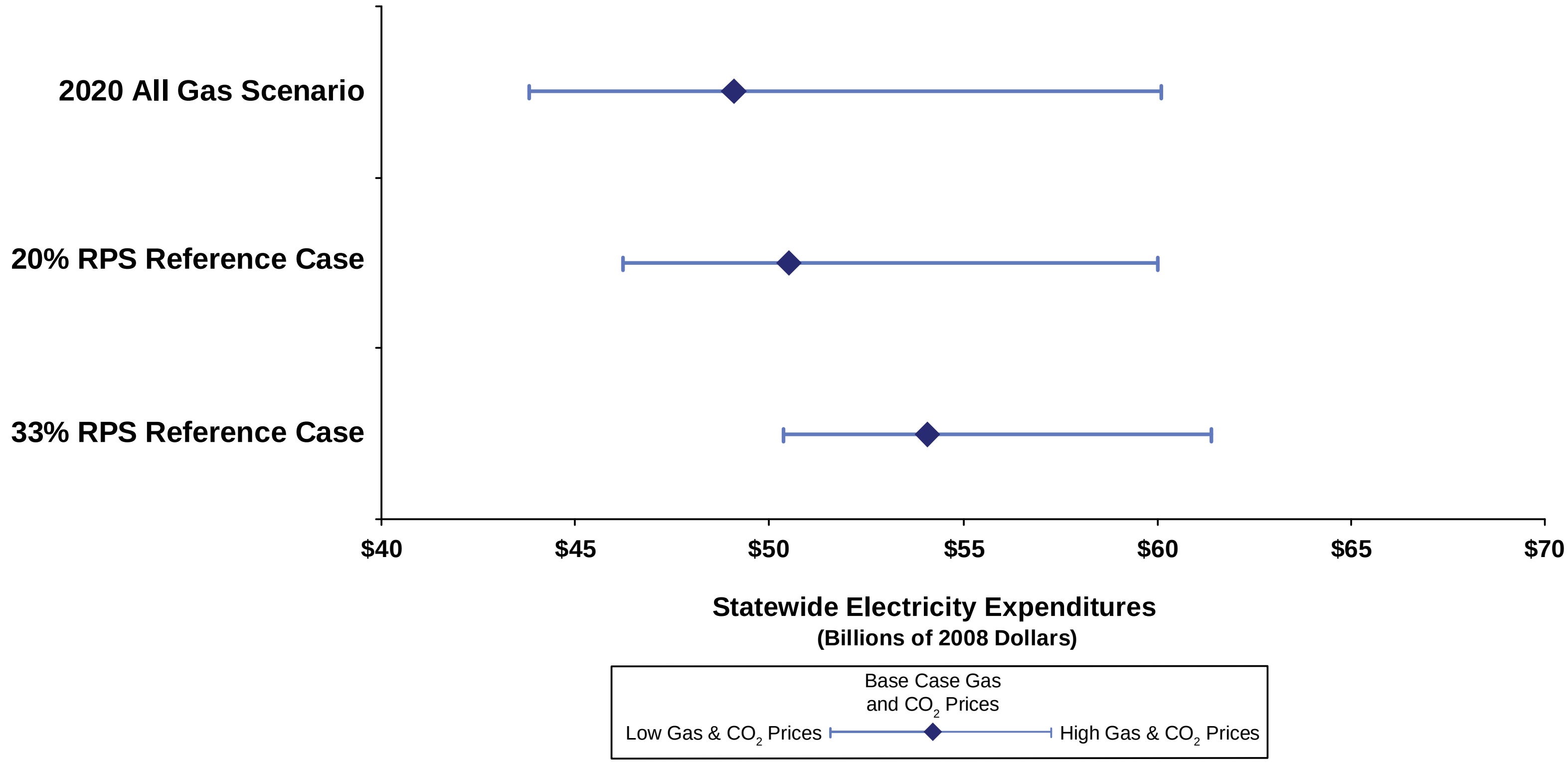
[1] The Energy Commission assumed the remaining 20% of the 2020 EE goals impacts were "uncommitted," and therefore excluded from the state's official forecast. In D.07-12-052, the CPUC assumed that 100% of the 2020 EE goal impacts would be realized for procurement purposes. The Energy Commission load forecast does not take into account the Big Bold goals the CPUC established in D.07-10-032.

# Renewable Resource Mixes in 2020 Under Different Cases




Source: CPUC/E3

# Impact of Gas and $CO_2$ Allowance Prices on Statewide Expenditures




- A 33% RPS can serve as a hedge against natural gas prices, but only under very high natural gas and GHG allowance prices
- Hedging value in itself is not a very strong justification to do a 33% RPS

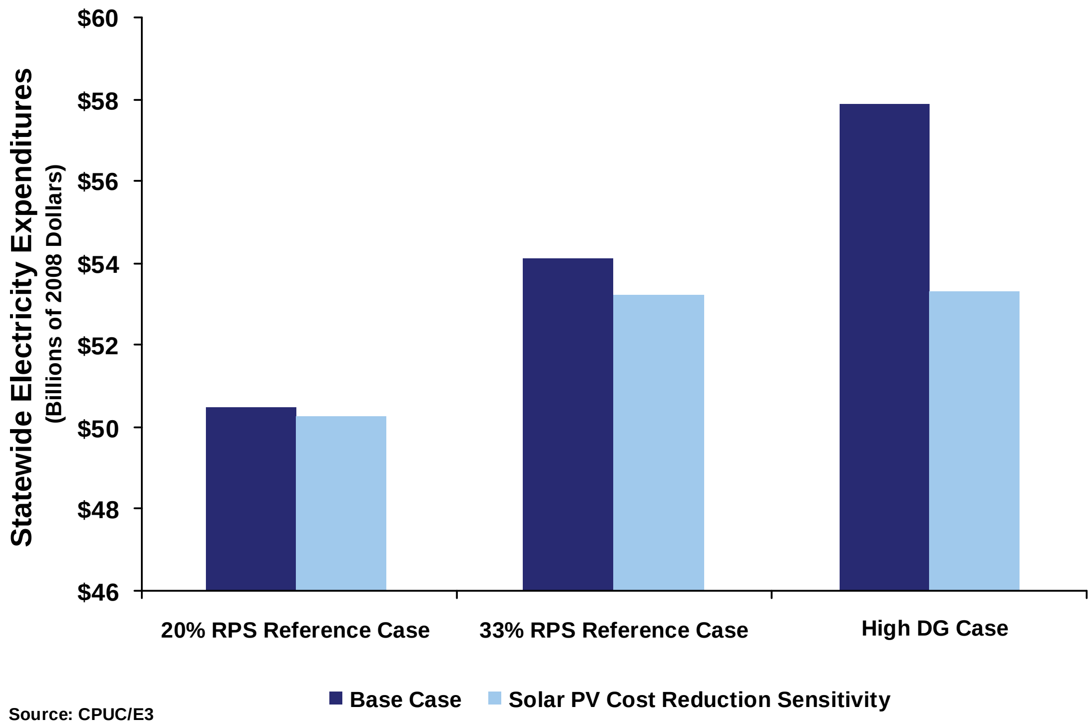
# Impact of High Energy Efficiency Achievement (Low-Load Sensitivity)

| Costs | Base Case Loads | Low-Load Sensitivity |
|---|---|---|
| Total Electricity Expenditures, 20% RPS Reference Case * | $50.6 | $46.4 |
| Total Electricity Expenditures, 33% RPS Reference Case * | $54.2 | $50.4 |
| Incremental cost of 33% RPS Reference Case * | $3.6 | $4.0 |
| Percent Difference Relative to 20% RPS Reference Case | 7.1% | 8.6% |

*Expressed in billions of 2008 dollars in 2020.

- The interplay between energy efficiency achievement and renewable energy procurement highlights the need to analyze and plan for the interactions among the state's various policy goals.
- If the state does not plan for interactions, then a 33% RPS by 2020 could result in a surplus of energy or capacity and excess consumer costs.

# Cost Savings Due to Solar PV Cost Reduction Sensitivity




Source: CPUC/E3

- Dramatic cost reductions in solar PV could make a solar DG strategy cost-competitive with central station renewable generation.
- More analysis is necessary to determine the programmatic strategies necessary to achieve a high-DG scenario as well as the feasibility of high penetrations of solar PV on the distribution grid.